

What Is Radiation? (Source: U.S. Nuclear Regulatory Commission)

All material is composed of atoms. Atoms are comprised of various parts—the nucleus that contains minute particles called protons and neutrons, and an outer shell made up of other particles called electrons. The nucleus carries a positive electrical charge, the electrons a negative electrical charge. As electrons are bound to the nucleus of the atom, so are the particles within the nucleus. These forces within the nucleus work toward a strongly stable balance. The process by which the nuclei of atoms work toward becoming stable is to get rid of excess energy. Unstable nuclei may emit a quantity of energy, or they may emit a particle. This emitted atomic energy or particle is what we call radiation.

- **Types of Radiation:** There are two basic kinds of radiation. One kind of radiation is tiny, fast-moving particles that have both energy and mass (weight) known as particle radiation. The other kind of radiation is pure energy with no weight. This kind of radiation is like vibrating or pulsating waves of electrical and magnetic energy. The radiation waves are called electromagnetic waves or electromagnetic radiation.
- **Ionizing/non-ionizing:** Ionization is the process of removing electrons from atoms, leaving two electrically charged particles (ions) behind. Some forms of radiation—like visible light, microwaves, or radio waves—do not have sufficient energy to remove electrons from atoms, and hence are called non-ionizing radiation. The negatively charged electrons and positively charged nuclei may cause changes in living tissue.
- **Radioactive Decay:** Large unstable atoms can become more stable by emitting radiation. This process is called radioactive decay. This radiation can be emitted in the form of a positively charged alpha particle, a negatively charged beta particle, or gamma rays.
- **Alpha particles** are easily shielded by a piece of paper or human skin. Therefore, health effects of alpha exposure occur only when the particles are inhaled or ingested, or enter the body through a cut in the skin.
- **Beta particles** are fast electrons produced following nuclear decay of certain radioactive materials. Six millimeters of aluminum are needed to stop most beta particles.
- **Gamma rays**, an electromagnetic wave, are similar in form to visible light and radio waves. Gamma rays are produced from radioactive decay, in nuclear reactions, and in fission. Gamma rays are dangerous because they have great penetrating ability. Several millimeters of lead are needed to stop gamma rays.
- **Fission or Nuclear Fission:** Some elements can split as a result of absorbing an additional neutron. This splitting is called fission or nuclear fission. Such isotopes are called fissile isotopes. One particular fissile isotope is Uranium-235, which is the isotope used in commercial nuclear reactors. When a nucleus fissions, three important events occur, which result in the release of energy. These events are: release of radiation, release of **neutrons** (usually two or three), and formation of two new nuclei (fission products).
- **Neutrons** trigger the nuclear chain reaction. Neutrons do not carry an electrical charge. However, when the neutrons hit the nucleus of hydrogen (a part of water molecules in cells), ionizations that can lead to damage can occur.

For additional information see the Nuclear Regulatory Commission website at: <http://www.nrc.gov/what-we-do/radiation.html>